Preface: A Guide to the Tosawihi Quarries Reports

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Introduction

Between 1987 and 1992, Intermountain Research (IMR) conducted a program of survey, testing, and data recovery at Tosawihi Quarries, north-central Nevada, for which I was project director. The work was done on behalf of various mining development consultants and gold mining companies (Galactic Services, Inc.; Ivanhoe Gold Company; Touchstone Resources Company; Newmont Exploration, Ltd.), and generated several reports comprising the most intensive look at a toolstone quarry yet conducted in North America. Not widely available before now, the Tosawihi reports have been compiled in this collection and distributed by the Nevada Bureau of Land Management (BLM) in electronic format. These files contain the key reports of the Tosawihi project that comprise our theoretical stance, research designs, descriptions, data and interpretations. To support the IMR reports, we add some supplemental materials: Callaway (1991, this collection) on the constraints and opportunities that shaped the project; contemporary White Knife Shoshone ethnography (Clemmer 1990, this collection; Rusco and Raven 1992, this collection), and the present state of the quarries (Hockett 2006, this collection).

I was asked by Pat Barker and Tom Burke, Nevada BLM, to recommend the best order in which to read these documents, since during the project we wished we could have done some things in a different order (Callaway 1991). But in re-reading the reports for this preface, I think they are best confronted in the order the work was conducted. In this way, the reader can see the project much as we saw it, and better understand the constraints under which we worked, and the decisions we made, good or not. Because each report was meant to stand alone, the reader will encounter in each, CRM boilerplate and reprises of the local environment, regional prehistory, and ethnography that can be safely skimmed after a certain point. The reports speak for themselves, but this preface should help the reader anticipate their contents.

The Project Unfolds

We now know that use of the quarries has a history from deep antiquity to the White Knife (*Tosawihi*) people of the Western Shoshone, even to the present day (Clemmer 1990, Rusco and Raven 1991). Toolstone from this source area, volcanic tuff transformed by hydrothermal activity into cryptocrystalline "opalite," is very high quality chert that can be obtained in large packages. Raw material from this source has been utilized more than 10,000 years, and is found at distances up to 300 km from the quarry (Lyons et al. 2003). Although the existence of the Tosawihi toolstone source was known to ethnographers (Harris 1940; Steward 1941), and modern flint knappers (Stephenson and Wilkinson 1969), it had been neither precisely located nor described by any scholar prior to Mary Rusco's series of unpublished reports of the 1970s. Her draft Tosawihi Quarry National Register District (NRD) nomination (Rusco 1983) showed that Tosawihi

Quarries was the largest prehistoric bedrock toolstone quarry in the Great Basin and one of the largest in North America. The intensity of prehistoric activity at Tosawihi Quarries was unprecedented and unexplained. Our involvement in the Tosawihi Quarries project offered a rare opportunity for a detailed study of this prehistoric toolstone quarry, as well as of the processing and residential sites associated with it.

Until we made the first site visit with our geologist client, we had only a vague idea of what Tosawihi Quarries represented (see Callaway 1991). On the ground there, we were impressed by the size and complexity of the place. A landscape of several hundred acres cratered with quarry pits and more or less continuously covered with debitage, Tosawihi seem to exemplify Ericson's (1984) characterization of toolstone quarries as a ".... *shattered, overlapping, sometimes shallow, nondiagnostic, undatable, unattractive, redundant, and at times voluminous material record.*" Even the Sugarloaf Obsidian Quarry in the Coso Volcanic Field, with which we had previous experience (Elston and Zeier 1984), was not so daunting. Nevertheless, our Coso experience convinced us that, given a systematic approach, toolstone quarries could be understood.

Our first goal at Tosawihi was, through intensive survey, to identify the kinds of archaeological phenomena present, and their distribution in the landscape (Elston et al. 1987, this collection). Our approach was developed in close consultation with Bureau of Land Management, Elko Resource Area (BLM) and the Nevada State Historic Preservation Officer (SHPO), Nevada Division of Historic Preservation and Archaeology. This consultation established the first priority as the area delineated by Rusco (1983) in her NRD nomination. Rusco's district boundary was a line drawn around what she had perceived to be the greatest density of quarry features and debitage: the "heart" of the quarries, as she expressed it to us. However, because BLM and SHPO found Rusco's curvilinear boundary difficult to describe in terms of metes and bounds, and thus problematic for a NRD nomination, we squared it off into a rectilinear form enclosing 812 acres (Elston et al. 1987, this collection). As so defined, the district was given the Smithsonian site number, 26Ek3032. Discrete archaeological features (defined in Elston et al. 1987) and complexes of features within 26Ek3032 were recorded as numbered localities.

Our 100-foot interval transect survey of 26Ek3032 employed the 400 foot grid staked by our mining client. On each transect, we recorded all cultural features, and for each 100-foot transect segment, estimated the average debitage density (none, sparse, light, moderate, heavy). These data were used to construct a debitage density to help define archaeological localities (Elston et al. 1987). As part of the intensive survey, we also investigated a smaller area within 26Ek3032 where the interest of the mining company was focused. Here we selected a sample of archaeological localities for closer scrutiny and description, including quarry features or complexes of features, as well as light to moderate density lithic scatters.

The intensive survey confirmed that the Tosawihi archaeological record was highly structured, and not a chaotic jumble after all. There were localities with a residential character, localities dominated by biface reduction debris, undifferentiated lithic scatters, isolated artifacts, and several types of quarries (cobble quarries, quarry pits, outcrop quarries) demonstrating different extraction strategies. Structure was imposed by the terrain in which drainages isolated ridges, by where opalite was exposed at or near the surface, by the availability of flat places for reduction and residential activities, by presence of surface water to support residential sites, and by the organization of toolstone extraction and reduction. We found it convenient to group archaeological features and localities on the basis of proximity to one another and their location on geographic features such as ridges, stream terraces, benches and alluvial flats (Elston et al. 1987:Fig.8). Nevertheless, the nearly continuous blanket of surface debitage in the study area sometimes required us to arbitrarily define locality and feature boundaries, leaving their final resolution to subsequent investigators and resource managers (e.g. Hockett 2006).

In passing, I note that subsequent add-ons to the project area were not incorporated into the NRD site 26Ek3032. Archaeological localities within these areas were designated sites and given Smithsonian numbers. Because all archaeological manifestations were given unique numbers, either as localities in site 26Ek3032, or as sites with their own Smithsonian numbers, this scheme worked well for purposes of evaluation and data recovery. However, it later proved to be unwieldy in terms of resource management, and was recently rationalized by BLM, who enlarged the NRD and converted surviving localities in the original 26Ek3032 to sites with Smithsonian numbers (Hockett 2006).

As mine development proceeded, specific impact areas were identified for evaluation: two mining areas adjacent the southern borders of 26Ek3032, the 480 acre USX West (Budy 1988), and the 170 acre USX East (Raven 1988), as well as the North Access Corridor Willow Creek up Ivanhoe Creek near its head west of Big Butte (Drews 1988). These first two survey reports are included in this collection, as is the report of subsequent testing (Elston 1989).

The surveys peripheral to the main quarry areas revealed considerable archaeological variability, due in part to underlying geology/geomorphology, and in part to differences in human use. The tuff- and basalt-dominated, steeper, more dissected USX West area lacked a continuous blanket of debitage where archaeological site boundaries were much more discrete than in NRD 26Ek3032. Site boundaries in USX East were more diffuse in a landscape ranging from gently rolling silt-covered tuff slopes, to a rhyolite mesa and rimrock, to alluvial stream terraces. Sites in the North Access Corridor were discrete lithic scatters on benches and terraces overlooking Willow and Ivanhoe Creeks. Compared to the area within NRD 26Ek3032, task-specific sites and residential sites were much more abundant (we tested 51), and quarries far fewer in these add-on areas (we tested 14). This allowed us to examine archaeological manifestations of behavior not directly involved with toolstone quarrying and initial processing, and to look at distance from toolstone source as a component of archaeological variability.

In the data recovery phase of the project (Elston and Raven 1992, this collection), the USX West and USX East areas became known as the Western and Eastern Peripheries, respectively (Leach et al. 1992; Botkin et al. 1992). Although the overall goal, shared by

BLM and the mining company, was to avoid archaeological localities in NRD 26Ek3032, disturbance could not be avoided at a few localities around its southern margin. Description of data recovery at eight of these localities is included in the Eastern Periphery (Botkin et al. 1992). A separate report (Leach and Botkin 1991, this collection) documents evaluations of localities 26 and 27 in site 26Ek3032, and site 26Ek3516. Localities 26 and 27 are both located along a short reach of Little Antelope Creek in the southeast portion of NRD 26Ek3032. These localities are, respectively, a small quarry pit complex on a strath terrace, and an open residential site on an alluvial terrace. Locality 27 has up to 140 cm of stratified alluvial and eolian sediments, and both localities contain strata with cultural material below Mazama tephra deposited at 7627± 150 cal yrs BP (Zdanowicz et al. 1999). A failed Clovis preform from the surface of North Corridor site 26Ek3237, made of chert resembling that from Butterscotch Ridge in 26Ek3032, suggests use of the quarries as old as 13,000 cal. yrs. B.P.

Also slated for disturbance by expansion of mining activity was Locality 36 in NRD 26Ek3032. Locality 36 presented an opportunity for an intensive look at a large quarry pit complex. Data recovery there (Elston and Raven 1992) included mechanical trenching and scraping, as well as hand excavation and surface collection.

A BLM Class II survey of nearly 29,000 acres surrounding Tosawihi Quarries (Leach and Botkin 1992) assessed the appropriateness of the proposed NRD boundaries, provided a baseline for cumulative effects of mining and related activities on cultural resources, and investigated archaeological variability beyond the core quarries area of NRD 26Ek3032. A concurrent overview of historic use of Tosawihi and vicinity (Rogers 1992) is included in the survey report.

Survey along the Silver Cloud Road led to the last IMR investigation at Tosawihi, the excavation of site 26Ek5040, 3 km southwest of Tosawihi (Ataman et al. 1995, this collection). Located near smaller opalite outcrops, this site was the scene of biface manufacture and manifested some short-term residential characteristics. Projectile point chronology and obsidian hydration suggested the most intensive occupation during the Middle Archaic (ca 5000-1300 B.P.), with a smaller Late Archaic component (probably less than 700 B.P.). Obsidian hydration and stratigraphy suggested a small pre-Mazama (7627± 150 cal yrs B.P.) component as well. Data from 26Ek5040 addressed technological change, site structure and technological organization; the distance fall-off model for Tosawihi opalite; and the role of the Humboldt River as an economic barrier in the obsidian trade.

Research Design and Analytical Approach

The initial survey of 26Ek3032 focused on describing archaeological variability across the landscape (Elston et al. 1987). Informed by this survey, we prepared a generalized research design (Elston 1988) to guide further archaeological investigations at Tosawihi Quarries. This document identified several related themes: the nature of toolstone quarries in general and Tosawihi in particular, economics of toolstone extraction and production, organization of lithic extraction and production, site formation processes and site structure at quarries and ancillary sites, and temporal variation in intensity of quarrying and lithic technology. This initial document is not included here, but a version appears as Chapter 2 (Budy et al. 1989) of *The Tosawihi Quarries: An Archaeological Testing Program* (Elston 1989).

As the project progressed, and we gained experience and understanding, research designs became more focused. The quarry pits and processing debris at Tosawihi appeared indicative of goal-oriented toolstone procurement, and investment of time and energy very different from casual collection embedded in other activities such as described for Nunamuit hunters (Binford 1979a:260). Not only did these activities seem costly in themselves, but diverted effort that could have been directed toward food gathering, reproduction and social interaction. Considering these competing demands for time and energy generated many questions: What were the physical goals of toolstone extraction and processing (toolstone quality, package size, products)? What were the techniques employed to accomplish these goals? How were quarrying, processing and residential activities organized within the quarry precinct? Did goals, techniques and organization change through time? How much effort was required in raw material extraction and processing? Was the amount of processing related to transportation costs? How could time spent at Tosawihi be best scheduled to fit into a seasonal round and mitigate opportunity costs?

The research design for data recovery in the Peripheries addressed these and other questions from the perspective of several models. A lithic procurement model (Elston 1992a, 1992b) was developed from theoretical considerations of cost, benefit, and risk (Belovsky 1987; Elston 1990; Metcalfe and Barlow 1992; Stephens and Krebs 1986). This, and models of central based foraging (Orians and Pearson 1979), mobility (Binford 1977, 1979a, 1979b, 1980), economic geography (papers in Earl and Ericson 1977; Ericson and Earl 1982; Ericson 1984), nearest neighbor analysis (Hodder and Orton 1976), and site formation processes (Schiffer 1976, 1987), helped address assemblage variability, site structure, function and distribution, technological organization, and lithic production and transport strategies, in addition to subsistence and chronology. Inspired by experimental and ethnographic studies of costs and benefits of food procurement and transportation (Simms 1987; Jones and Madsen 1989; Metcalfe and Barlow 1992; Rhode 1990), our lithic production model employed data from experimental quarrying (Carambelas and Raven 1991) and processing contributed by participants of the Tosawihi Knap-in, and IMR staff members, Kathy Ataman, Bill Bloomer and Mark Moore. In the testing phase, analysis was heavily weighted toward tools and bifaces (most of which were preforms), while debitage was characterized only by counts, weights and raw material. For data recovery in the Peripheries, we added technological and mass debitage analyses (Bloomer and Ingbar 1992). All recovered debitage was subject to mass analysis through graded screens (Ahler 1989a, 1989b), while technological analysis was used for selected debitage samples. For technological analysis, the flake typology was based on our experimental debitage assemblages. Discriminant models for mass debitage analysis were derived our experimental data combined with experimental replication data from the Knife River Flint Quarry project, very kindly shared by Stanley Ahler.

The research design for data recovery at Locality 36 focused more tightly on aspects of the lithic procurement model, and on site structure, assemblage variability and site formation processes. In particular, we were interested in the role of rate-maximizing strategies for toolstone procurement, the efficiency of particular extraction techniques, and the organization of quarrying. These were all topics we had considered before, but Locality 36 offered the opportunity to explore them in some depth.

Locality 36 debitage analyses followed the same general strategies used in the Peripheries study, employing both technological and mass analysis. However, previous experience at Tosawihi suggested some refinements and new approaches to analysis. To more closely approximate the initial processing expected within a quarry pit complex, we conducted an additional 100 experimental reductions beginning with opalite blocks, and used these data to generate new discriminant models. The technological analysis was simplified by using a flake typology that reflected one of five reduction stages (quarrying, mass reduction, bank preparation/initial edging, early biface thinning and late biface thinning). We made considerable use of machine excavation to trench through quarry pits. This not only exposed the stratigraphic record of Locality 36, but also revealed the bedrock and the extent of its human modification, allowing us to evaluate the relative importance of toolstone quality vs. ease of extraction.

The Class II survey was designed to examine aspects of our lithic procurement and transport models, including availability of quality toolstone sources outside the main quarries in 26Ek3032, the existence of a regional "zone of production," and the distribution of residential sites in the region (Leach and Botkin 1992). The study area was divided into 1446 quadrats and divided into strata according to presence or absence of surface water and toolstone. Ten percent of the quadrats in each stratum were selected for investigation. No artifacts were collected on survey; debitage density was estimated, formed tools tallied and described, bifaces and projectile points were measured and traced in outline and bifaces were assigned to a pre-defined technological stage.

The goal of data recovery at site 26Ek5040 was to take a detailed look at a short-term residential site removed from the main quarries but near secondary toolstone sources. Testing the site suggested a major Middle Archaic component there that we compared with the Late Archaic technology so prevalent in the Peripheries and much of Locality 36.

What We Learned at Tosawihi

Tosawihi Quarries taught us a lot about bedrock toolstone extraction, processing and distribution. Here are some important things we learned.

The Clovis preform from 26Ek3237, and numerous Great Basin Stemmed points from the Tosawihi project areas suggest that the quarries were a toolstone source from the earliest times. However, use of the quarries seems to have grown more intense during the Late Archaic, beginning about 1500 years ago.

Our techniques of lithic analysis worked well enough. We were able to compare mass analysis with technological analysis based on flake-types and biface stages, concluding that the latter, performed by well-trained lithicists, is as efficient and more accurate than the former. Both techniques, however, depend on the availability of data from well-executed experimental reductions.

As predicted by benefit/cost models, Tosawihi quarriers sought particular qualities of toolstone and types of bedrock exposures that minimized extractive efforts and maximized toolstone output. For the most part, raw toolstone was transformed into bifaces, and transported from the quarries at a reduction stage that proved toolstone quality, facilitated heat treatment, and minimized transportation costs. The focus on biface production seems to be as ancient as the quarries themselves. We did not observe core and blade technology at Tosawihi, but we did not have the opportunity to look very closely at what we suspect are the oldest parts of the quarry precinct: Butterscotch Ridge and the outcrop quarries along the margins of Velvet Canyon buried by debitage and quarry waste talus.

Bedrock quarrying at Tosawihi produced distinctive types of anthropic and natural sediments that tend to alternate in systematic ways, suggesting intervals of activity and abandonment. The use of fire to attack bedrock frequently left charcoal in these sediments, which along with occasional bone and antler digging tools can provide radiocarbon dates. It may also be possible to date fine sediments accumulated in quarry pits by optically stimulated luminescence (OSL), but this has yet to be demonstrated.

The organization of extraction and processing created a structured distribution of artifacts, with quarry features surrounded by umbras of quarry waste and debitage dominated by early stage reduction, and processing stations and processing/residential sites dominated by later stage debitage. Processing stations are generally located away from quarries, in flatter places more comfortable to work, while residential site location favored places near at least seasonal water. Residential sites at Tosawihi contain domestic and hunting-related tools, and sometimes hearths, but all those we examined suggest only short-term occupation supplied by local resources. Thus, all the debitage and quarry features at Tosawihi represent the accumulated byproducts of thousands of years of toolstone extraction and processing during short-term visits to the quarries by individuals and small groups.

Within 26Ek3032 (the main quarry precinct) and the Peripheries, there is a strong trend toward decrease in biface size and stage, and increase in heat-treatment, with distance from quarry features that is predicted by our transportation cost model, and this trend is also evident in the Class II regional survey. However, the Class II survey revealed more medium-sized debitage and Stage 2 and 3 bifaces than expected in the area surrounding 26Ek3032 and the Peripheries, due we suspect, to the presence of small opalite sources scattered through the region.

Prospects for Future Research

Mining activities at Tosawihi greatly altered the look and feel of the place, but did not encroach much into 26Ek3032 and its localities, Rusco's "heart of the quarry." Mining did not extend into Locality 36 after all. Because we (and BLM and SHPO) thought that Locality 36 would soon be destroyed, we did not backfill our excavations there, so that our trenches with their bedrock exposures remain open for viewing, an unforeseen benefit for research and education. Mining did not encroach, after all, on 26Ek3032 localities 26 and 27, so their pre-Mazama and later records are preserved for future study. However, virtually all of the quarries, processing stations and residential sites in the Peripheries are gone, documented only by our reports, data, and collections. Although there are similar sites north of 26Ek3032, they do not occur in the same density and close proximity to the main quarry precinct as those in the Peripheries.

There is a great deal more to be learned from Tosawihi Quarries. It has deep antiquity, but its chronology is sketchy. While we know that Clovis and pre-Archaic people obtained toolstone there, we know nothing about the earliest extraction and processing technology, and relatively little about the Early and Middle Archaic use of the quarries.

Faced with huge debitage and biface samples, our lithic analysis techniques were designed to be as efficient as possible. Perhaps different data recording and statistical approaches would reveal trends and relationships that we missed.

Our Class II survey failed to discover the boundary of the production zone around Tosawihi, beyond which the transportation model predicts that late stage debitage and bifaces will fully prevail in archaeological assemblages. Another boundary that requires attention is the black/white line described by Stephenson and Wilkinson (1969) from about Iron Point on the Humboldt River, northward. West of this line (more a zone), surface debitage assemblages are "black," dominated by Paradise Valley obsidian, and east of the line, assemblages are "white," dominated by Tosawihi chert. While this strongly suggests an economic boundary for the two toolstones likely determined by distance from source, the black/white zone also runs roughly along the boundary between the Northern Paiute and Western Shoshone, so perhaps the black/white line is a cultural delineator as well. If so, it appears to be older than the Numic Expansion.

We also know that Tosawihi chert in a late archaeological context reached central Oregon, some 300 km from the quarries (Lyons et al. 2003); ethnographic accounts indicate trade to even more distance places. Was Tosawihi toolstone always so widely traveled or is this related somehow to the increased intensity of quarrying activity at Tosawihi from about 1500 B.P.? Why would people devote more time to quarrying and making white knives then – was this driven by trade? If so, what was traded and where?

All of us who worked on the Tosawihi project, with the exception of Bill Bloomer (Bloomer 1991), have been remiss in publishing on Tosawihi. I hope the digital distribution of these of these reports will stimulate publication and additional research.

Our archaeological and experimental collections from Tosawihi, comprising more than million artifacts and other samples, and all of our data are housed at the Nevada State Museum in Carson City, Nevada. These materials are available for study by any qualified researcher.

A Last Word

The Tosawihi project was about as close to a dream job as one can get in CRM archaeology. The IMR staff and crewmembers on the project were the best in the business. IMR General Manager Cashion Callaway made everything (budgets, schedules, personnel, logistics, proponent/agency relations) work, and edited the reports as well. We had great field camps throughout the project and were cared for by Mr. Jimmy Olsen, the world's best camp cook. As always in CRM, we were pushed for time, but we had a lot of it, along with sufficient resources. It was obviously very important to do as well as possible by Tosawihi, and this fostered a rare degree of cooperation between us, the mining proponent, and regulating agencies. Thanks to all who worked on, helped with, and encouraged the Tosawihi project, and thanks to Pat Barker and Tom Burke for making this collection possible.

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